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# The Hazardous Components and Prevailing Rate of Sarcopenic Obesity in Younger Women : Based on 2008-2011 Korean National Health and Nutrition Examination Surveys

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**Abstract**

**Purpose** : Sarcopenic obesity is associated with adverse health consequences in females. Nevertheless, there has been limited research on the hazardous components and prevailing rates of sarcopenic obesity among younger women. This study aimed to identify the hazardous components and prevailing rates of sarcopenic obesity in younger females.

**Methods** : This study utilized data based on 2008~2011 from the Korea National Health and Nutrition Examination Surveys by the centers for disease control and prevention. The analysis was concentrated on a subset of 1,520 women aged between 30 and 39 years of age. The participants answered a questionnaire to gather demographic information. They then underwent a physical examination to measure the human detention variables, which was conducted utilizing bioelectrical impedance analysis. The blood pressure and blood laboratory tests were determined using established laboratory protocols for evaluating blood parameters.

**Results** : This study included 1,520 patients aged 30~39 years old. The mean age of the participants was 34.97 (years)±2.74 and the overall prevailing rate was 1.84 %. The hazard components in human dimensions were the height, weight, body mass index (BMI), waist circumference (WC) and skeletal muscle mass index (SMI). The hazard components in biochemical and blood pressure were high fasting glucose, increased triglyceride, elevated total cholesterol, high systolic blood pressure, and increased diastolic blood pressure with p-values <.05.

**Conclusion** : This study examined the hazardous components and prevailing rates of sarcopenic obesity in younger women living in the community. The results contribute to the current body of knowledge on sarcopenic obesity and shed light on possible hazardous components in a younger female population. Based on these findings, there should be increased health and medical attention towards the prevention, management, and health promotion related to reducing risk factors for sarcopenic obesity in younger women.

**Key Words :** hazardous components, odds ratio, prevailing rates, sarcopenic obesity

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# Ⅰ. Introduction

Sarcopenic obesity (SO) refers to a medical state marked by the combination of sarcopenia and obesity (Donini et al., 2022). Sarcopenia is related to the age-related decline in muscle mass, causing diminished muscle strength, endurance, and function (Hirani et al., 2017). Obesity is defined as the excessive accumulation of fat mass in the body. SO arises when individuals have sarcopenia and obesity, leading to adverse health consequences, such as reduced physical function, impaired metabolic function, diminished quality of life, and an elevated risk of mortality (Donini et al., 2022).

The presence of obesity and low muscle mass has adverse effects on health and plays a role in the onset of chronic diseases and disability. This can result in prolonged hospitalization that strains healthcare initiatives and policymaking efforts. Studies suggest that individuals with SO experience poorer health outcomes than those with low muscle mass or obesity alone (Roubenoff, 2004; Zhang et al., 2019). Furthermore, diagnosing and understanding the clinical implications of this condition can be challenging because of the interference of obesity with the development and upkeep of muscle mass (Prado et al., 2014).

Furthermore, SO has higher prevailing rates among women than men (Newman et al., 2003). Newman et al.(2003) conducted a study in the United States involving 2,917 adults. They reported that women had a greater prevalence of SO than men, with rates of 11.5 % and 14.5 %, respectively. Stenholm et al.(2008) evaluated more than one thousand people the Western country and mentioned 5.1 % and 5.9 % incidence rates for men and women, respectively. Therefore, women are more prone to experiencing a combination of reduced skeletal muscle mass and increased body fat associated with SO than men. Identifying hazardous components and effectively managing SO among the female population poses challenges. These challenges become particularly apparent When examining the existing studies on SO in women with the well-established studies conducted on men (Atkins et al., 2014).

Most research on SO focused on individuals 40 years old and older (Hwang & Park, 2022a; Hwang & Park, 2022b; Hwang & Park, 2023). On the other hand, emerging evidence suggests that the development of sarcopenia and obesity can commence as early as the 30s (Cruz-Jentoft et al., 2019; Janssen et al., 2002). Considering the importance of preventative strategies for age-related muscle loss earlier, it is essential to identify the hazardous components among younger women.

This study examined the prevailing rates and identified hazardous components related to sarcopenic obesity among women aged 30 to 39 years living in the community. The research hypotheses considered two potential scenarios: there would be distinct prevailing rates of SO among younger-aged women residing in the community, and specific hazardous components would be related to SO in young females.

# Ⅱ. Methods

### 1. Population selection of participants

This study utilized data from the Korea National Health and Nutrition Examination Surveys (KNANES). From 2008 to 2011, 37,573 individuals actively participated in the survey. On the other hand, for the specific focus of this study, 34,402 individuals were omitted from the research. This is because subjects did not fit within the specified age bracket. of 30~39 year-old women. This led to a final sample size of 3,171 participants. The study excluded 1,651 participants who are not took a dual-energy X-ray absorptiometry examination and had not responded to the health survey. As a result, the final analysis was concentrated on a subset of 1,520 women aged between 30 and 39 years of age (Fig 1). These participants were separated into two groups in accordance with their skeletal muscle mass index degree. The first group, referred to as the SO group, consisted of 62 individuals who met two specific criteria: 30 to 39-year-old women and exhibiting both sarcopenia and obesity. The normal group was composed of individuals who met the following criteria: women aged between 30 and 39 years and not presenting with sarcopenia or obesity.

Specific exclusion criteria were also applied, excluding pregnant women and people experienced a diagnostic procedure involving a contrast agent within one week before the test.

Ethical considerations were observed rigorously, with the study securing authorization from the institutional review board of the Korean center for disease control and prevention. In addition, all participants provided well-informed written consent to participate in the research in accordance with the Korean center for disease control and prevention guidelines.

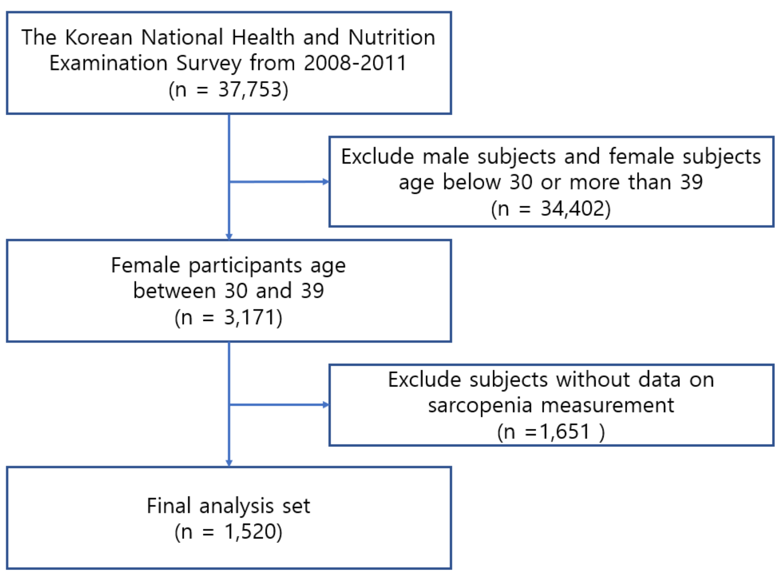


Fig 1. Flowchart for selection of participants

**2. SO definition**

SO was diagnosed based on the combination of sarcopenia and obesity. Sarcopenia is a medical condition identified by the ICD-10-CM code (M62.84) in U.S, based on ICD-10, a global classification of illnesses released by the World Health Organization (WHO). In Korea, sarcopenia received an ICD-10-CM (M62.5) code with the eighth revision of the Korean classification of diseases. Sarcopenia diagnosed by measuring appendicular skeletal muscle mass (ASM). ASM is evlauated by dual X-ray absorptiometry (DEXA) technology, specifically the QDR4500A model manufactured by Hologic, Inc. located in Bedford, USA. The skeletal muscle mass index (SMI) was determined by dividing the measured ASM (in kilograms) by the body mass index (BMI) measured in kilograms per square meter ($kg/m^2$). The sarcopenia diagnosis criteria followed the guidelines established by the Foundation for the U.S. national institutes of health sarcopenia project. Sarcopenia among women was characterized by an SMI below .521. (Studenski et al., 2014). This method ensures the precise diagnosis of sarcopenia within the study population, adhering to the specific SMI thresholds set by the Foundation for the national institutes of health sarcopenia project (Studenski et al., 2014). Obesity is identified by the abnormal or disproportionate buildup of body fat, leading to potential negative impacts on health. It is typically identified by a BMI≥25 (kg/㎡) and central obesity. Central obesity is determined by a waist circumference (WC) exceeding 80 (㎝) in females within the Asian population (World Health Organization, 2000).

### 3. Variables

#### 1) Human dimensions variables

In this study, human dimension measurements were taken using a standardized procedure. The height and weight were measured with precise automated body measurement equipment. The recorded values were rounded to the nearest tenth of a centimeter (㎝) or kilogram (㎏). The BMI was then calculated by dividing the weight (㎏) by the square of the height (㎡). The waist circumference (WC) was precisely measured to the nearest tenth of a centimeter (cm) horizontally, positioned at the midpoint between the bottom of the rib cage and the top of the pelvic bone, following a regular exhale.

#### 2) Blood pressure and blood laboratory tests

The blood pressure cuff was positioned at the heart level while participants were seated, following a minimum resting period of five minutes.

For blood laboratory analyses, the fasting glucose (FG), triglyceride, and total cholesterol (TC) levels were assessed using the LABOSPECT 008AS platform manufactured by Hitachi High-Tech Co. in Japan. Blood samples were obtained from the non-dominant arm following a minimum overnight fast of eight hours. The blood collected was promptly mixed with an agent to induce coagulation, and then subjected to centrifugation inside a mobile testing facility. All examinations were conducted within a twenty-four hours timeframe following sample collection to guarantee precise analysis.

### 4. Data Analysis

The data in this study are reported as the mean and standard deviation, and the central tendencies and variations for each variable were analyzed. The statistical software used for the analysis was SPSS 22.0 (IBM Corporation, USA). The weight values were incorporated into the study to represent the entire Korean population. Each participant was assigned a sample weight through a rigorous three-step process: calculation of the base weight, adjustments to account for non-responses, and post-stratification adjustments to align with the population distribution from the most recent census. Complex sampling analysis was used for all data assessments, considering the impact of these weight values. The differences between the SO and the normal groups were compared using independent t-tests for parametric variables and chi-square tests for the non-parametric variables. Moreover, multiple logistic regression analyses were carried out, incorporating adjustments for covariates. This approach aimed to predict the presence of SO and determine the odds ratio of SO hazardous components, with a specific focus on females. If the odds ratio is greater than 1, it indicates that the probability of the event occurring increases as the predictor variable increases. If the odds ratio is less than 1, it indicates that the probability of the event occurring decreases as the predictor variable increases. The significance threshold for all variables was established at .05 according to the predetermined alpha level that served as the threshold for establishing statistical significance in this study.

## Ⅲ. Results

### 1. Prevailing Rates of SO

After adjusting the weighted values, the prevailing rate of SO was calculated to be 1.99 % (with a 95 % confidence interval of (1.26~3.15)). On the other hand, the prevailing rate of SO was 1.84 % when not factoring in weights, while the prevailing rate of normal muscle mass was 98.16 % (Table 1).

Table 1. Prevailing rates of SO

| | Sarcopenic obesity (n= 62) | Normal (n= 1,492) | Total (n= 1,520) |
|---|---|---|---|
| Un-weighted (%) | 1.84 | 98.16 | 100 |
| Weighted (%) | 1.99 (1.26~3.15) | 98.01 (96.85~98.74) | 100 |

The weighted values present the 95 % confidence interval

**2. Hazardous Components**

1) Human dimension variables:

In the current investigation, The hazard components in the human dimension were the height (㎝), weight (㎏), BMI (㎏/㎡), and waist circumference (㎝), and the skeletal muscle mass index (㎏/㎡) exhibited a noteworthy distinction between the two groups, with a significance level of $p<.01$, as listed in Table 2.

Table 2. Age, human dimension, and skeletal muscle mass index

| | SO (n= 62) | Normal (n= 1,492) | *p* |
|---|---|---|---|
| Age (years) | 35.57±2.73 | 34.83±2.78 | .159 |
| Height (㎝) | 152.53±4.29 | 159.94±5.08 | .000 |
| Weight (㎏) | 70.23±9.99 | 53.16±5.45 | .000 |
| BMI (㎏/㎡) | 30.16±3.87 | 20.78±1.89 | .000 |
| WC (㎝) | 90.56±8.08 | 70.64±5.14 | .000 |
| SMI (㎏/㎡) | 498.71±16.74 | 684.01±78.25 | .000 |

SO; sarcopenic obesity, BMI; body mass index, WC; waist circumference, SMI; skeletal muscle mass index

2) Biochemical components and blood pressure

The study identified statistically significant variations between the two groups in the fasting glucose, triglyceride, total cholesterol, systolic blood pressure, and diastolic blood pressure with p-values<.01 (Table 3).

Table 3. Biochemical and blood pressure components

| | SO (n= 62) | Normal (n= 1,492) | *p* |
|---|---|---|---|
| FG (㎎/㎗) | 102.12±16.78 | 89.20±12.00 | .000 |
| Triglyceride (㎎/㎗) | 125.52±47.05 | 80.77±54.38 | .000 |
| TC (㎎/㎗) | 198.44±46.80 | 170.88±28.62 | .000 |
| SBP (㎜Hg) | 112.64±10.69 | 104.31±10.58 | .000 |
| DBP (㎜Hg) | 75.54±9.95 | 69.18±8.53 | .000 |

SO; sarcopenic obesity, FG; fasting glucose, TC; total cholesterol, SBP; systolic blood pressure, DBP; diastolic blood pressure

### 3. Odds ratios for hazardous components:

Table 4 lists the odds ratios for the hazardous components. Age, height, weight, BMI, WC, SMI, FG, triglyceride, TC, and DBP exhibited significant associations between the two groups, with p-values<.01. The corresponding values were as follows: Age, .62 (.43~.89); height, .00 (.00~.00); weight, 2.30 (1.96~2.69); BMI, 5.480 (4.77~6.34); WC, 6.136 (4.36~8.63); SMI, .00 (.00~.00); FG, 1.05 (1.03~1.07); Triglyceride, 1.02 (1.01~1.02); TC, 1.12 (1.10~1.15); DBP, 1.40 (1.19~1.64).

Table 4. Multiple logistic regression for the odds ratio of SO

| Variables | Odd ratios (95 % of CI) | *p* |
|---|---|---|
| Age | .62 (.43~.89) | .011 |
| Height | .00 (.00~.00) | .000 |
| Weight | 2.30 (1.96~2.69) | .000 |
| BMI | 5.48 (4.77~6.34) | .000 |
| WC | 6.14 (4.36~8.63) | .000 |
| SMI | .00 (.00~.00) | .000 |
| DBP | 1.40 (1.19~1.64) | .000 |
| FG | 1.05 (1.03~1.07) | .000 |
| Triglyceride | 1.02 (1.01~1.02) | .000 |
| TC | 1.12 (1.10~1.15) | .000 |

SO; sarcopenic obesity, BMI; body mass index, WC; waist circumference, SMI; skeletal muscle mass index, SBP; systolic blood pressure, DBP; diastolic blood pressure, FG; fasting glucose, TC; total cholesterol

## Ⅳ. Discussion

The current research examined the prevailing rates of SO and its associated hazardous components in a community-dwelling population aged 30–39 years. Healthcare professionals, including physical therapists, occupational therapists, and primary care clinicians, often encounter challenges in accurately diagnosing SO because of their limited knowledge and access to diagnostic tools. This resource deficiency can lead to missed diagnoses and potential complications with SO.

Therefore, this study examined a range of variables, including human dimensions, biochemical components, alcohol consumption, and tobacco use. These variables were selected for their practicality and ease of access, making them valuable tools for identifying potential SO cases. The hazardous components identified in the study encompassed the fasting glucose, triglyceride, and total cholesterol levels, and the SBP and DBP.

The high fasting glucose level was identified as a hazardous component for SO in women, which aligns with the findings from several studies (Du et al., 2019; Lim et al., 2010; Lu et al., 2013). Du and colleague (Du et al., 2019) conducted a study in East China involving community-dwelling adults. They reported that women with SO had higher glycemic levels than those without SO. Similarly, Lim et al. examined more than 500 individuals and reported that women with SO exhibited elevated fasting glucose levels compared to their counterparts without SO (Lim et al., 2010). Lu et al. (2013) evaluated a population in Taiwan and reported that individuals with SO had higher fasting blood glucose levels than those without SO. The post-meal glucose levels are regulated mainly by the skeletal muscle, which plays a pivotal role in absorbing a substantial amount of glucose through various mechanisms, encompassing insulin-dependent and insulin-independent processes. This involves the movement of glucose from the bloodstream to the muscle tissue, its passage through cellular barriers, and its distribution within muscle cells. The glucose uptake by muscles is facilitated by glucose transporters, regulated by intracellular glucose metabolism, and dependent on the glucose concentration gradient (Hulett et al., 2022). Consequently, impaired carbohydrate metabolism can hinder the glucose uptake by skeletal muscles, affecting the post-meal glucose levels.

Increased triglyceride levels have been identified as hazardous components for SO. The outcome is consistent with previous research on SO (Du et al., 2019; Lu et al., 2013). For example, Du and colleague (Du et al., 2019) assessed community-dwelling adults. They reported that individuals with SO had higher triglyceride levels than those in the normal group, but no significant differences were observed between the SO and normal groups in women. Similarly, a Taiwanese community-dwelling study (Lu et al., 2013) reported significant increases in triglyceride levels between the SO and normal groups.

Elevated total cholesterol levels have emerged as hazardous components for women with SO, a finding supported by several studies (Du et al., 2019; Lu et al., 2013; Perna et al., 2017). A cross-sectional study conducted in eastern China (Du et al., 2019) showed that female participants with SO exhibited higher total cholesterol levels than those in the normal group. Lu et al. (2013) also reported higher cholesterol levels in the SO group than in the normal group. Perna et al. (2017) focused on Italian subjects and revealed significantly higher total cholesterol levels in the blood of the SO group than in the healthy group. One potential explanation for the elevated triglyceride and total cholesterol levels might be insulin resistance (Cleasby et al., 2016) and elevated levels of inflammatory cytokines (Schrager et al., 2007).

Hypertension, encompassing the SBP and DBP, was established as a hazardous component for SO, which is consistent with previous research studies (Lu et al., 2013; Yin et al., 2021). For example, a Northwest Chinese cohort study (Yin et al., 2021) found that SBP among females was higher in the SO group than in the normal female group, which had an SBP of 130.58 ㎜Hg. In addition, the DBP among women in the SO group was also higher than those in the normal group. Similarly, individuals in the SO group exhibited elevated DBP. Lu et al. (2013) evaluated 600 Taiwan community-dwelling adults. They reported that the SO group had a higher SBP than the normal population. The DBP was higher in the SO group than in the normal group. The observed increase in the SBP and DBP can be attributed to several underlying factors. One of these factors is the interconnected relationship between muscle loss and metabolic changes. This interdependence can lead to a decrease in energy expenditure and a decrease in physical activity.

Consequently, these factors contribute to the development of insulin resistance and an increase in arterial stiffness (Dominguez & Barbagallo, 2007; Ferreira et al., 2004; Snijder et al., 2004). Another significant factor is visceral fat accumulation, which triggers an inflammatory response. This inflammation causes thickening of the blood vessel walls, obstructs blood flow, and narrows vascular passages (Goswami et al., 2020). The reduced muscle mass and adipose tissue accumulation in the visceral region may play a role in the hypertension observed in men with SO.

These results provide valuable insights into the prevailing rate and specific hazardous components associated with SO in a community-dwelling younger female population in Korea. The study used representative data from the Korean population and employed the gold standard DEXA measurement technique for precise SO diagnosis. Nevertheless, this study had some limitations. The cross-sectional design hampers its ability to establish causal relationships. Hence, a longitudinal approach involving repeated measurements of the same individuals at different time points would strengthen the findings. Furthermore, the small number of studies focusing on younger women with SO presents challenges in making meaningful comparisons with other research, especially regarding the prevalence and other risk factors within this age group. Finally, data on sarcopenic obesity only exists for the years 2008-2011 in the Korean National Health and Nutrition Examination Survey. Thus, recent data has not been included. If recent data were to be incorporated, the present study provide a more valuable analysis on the prevalence and hazardous components of muscle sarcopenic obesity among the population.

## Ⅴ. Conclusion

This study examined the hazardous components and prevailing rate associated with sarcopenic obesity in younger women adults residing in Korean communities. Among females, this study found a 1.99 % rate of SO. The outcomes related to hazard components in the human dimension were identified as height, weight, body mass index, waist circumference, and skeletal muscle mass. The hazardous components in biochemical and blood pressure were increased fasting glucose, high triglyceride, elevated total cholesterol, high SBP, and increased DBP. More longitudinal research involving repeated measurements of the same individuals at multiple time points is needed to ensure reliability and provide more robust evidence. This approach would strengthen the credibility and validity of the study findings. Based on these findings, there should be increased health and medical attention towards the prevention, management, and health promotion related to reducing risk factors for sarcopenic obesity in younger women.

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